TEXAS BUSINESS REVIEW

Bureau of Business Research • College and Graduate School of Business • The University of Texas at Austin

JANUARY 1998

Austin *Sui Generis*?

The Strength and Resilience of the High-Tech Complex

by Dr. Michael Oden

Visiting Lecturer
Community and Regional Planning Program
University of Texas at Austin

Since the late 1980s, the growth of the Austin regional economy has outpaced that of other medium-sized high-tech centers, such as Raleigh-Durham, Phoenix, and Colorado Springs.[1] From 1988–1994, high-tech manufacturing employment in the Austin region grew by a remarkable 56 percent, while employment in the computer and data processing services increased by more than 100 percent. Austin's economic expansion was based on four private sector growth drivers: computer and office equipment, electronic and electrical equipment, software, and research and engineering services. Each sector showed rapid employment growth, a strong regional export posture as measured by industry location quotients, and robust growth in the number of establishments.

Despite this impressive performance, questions linger about the stability and dynamism of this high-tech complex. With employment in the computing and microelectronics industries only one-fifth that of the San Jose-San Francisco complex and one-half that of Dallas-Fort Worth, Austin remains a second-tier center. In addition, the prominent microelectronics manufacturing industries are dominated by large firms headquartered outside the region.

Measures of Regional Dynamism

How strongly anchored are Austin's major high-tech manufacturing and service firms to local suppliers, research institutions, and labor markets? Are Austin firms and research organizations generating product innovations that will lead to major sales expansions for local establishments? Are local firm start-ups or expansions playing a greater role in the regional growth process?

To answer these questions, the author and his students analyzed secondary data on the region and surveyed key informants at 24 high-tech firms.[2] These included ten manufacturing firms in the electronic components and computer and office equipment industries; two large firms with a mix of manufacturing, research, and software activities; and twelve firms in the computer service and software sectors. Eight firms had fewer than 100 employees; ten, between 100 and 1,000 employees; and six, more than 1,000. While not statistically representative, the survey encompasses the broad mix of Austin high-tech firms by sector and size, and nearly 60 percent of the region's high-tech workers were employed by the firms interviewed. Interviews were also conducted at five major university and private research centers and a number of education and training institutions, venture capital firms, and local business associations.

The Importance of the Region to the Competitive Position of Major Firms

Large, externally owned firms dominate Austin's high-tech manufacturing. Three firms—Motorola, IBM, and Advanced Micro Devices (AMD)—employ close to

21,000 people. Research revealed that these firms were much more than branch assembly or processing facilities. For example, the Oak Hill complex serves as world headquarters for Motorola's communications and advanced consumer technologies, microcontroller technology, and microprocessor and memory technologies groups. A sprawling north Austin campus houses one of IBM's major regional R&D centers and units involved in designing work stations and pioneering software products. And although their next generation microprocessors are designed elsewhere, AMD's local Fab-25 facility is the pilot plant for their latest K-6 generation and the locus of state-of-the-art development of fabrication process technology.

Of the 24 companies interviewed, 21 conduct research and development in their Austin facilities. Nearly 75 percent had increased their local R&D spending in the last five years. Moreover, 74 percent reported that major investment decisions were made by management at their Austin operations, suggesting that local decision making was crucial in ongoing operations.

Of the 24 companies interviewed, 74 percent reported that major investment decisions were made by management at their Austin operations, suggesting that local decision making was crucial in ongoing operations.

The importance of local supplier-customer relationships to the firms' business operations is a more complicated issue. Circumstantial evidence points to an increasing basis for local interfirm trade within the high-tech manufacturing segment. The growth of the special industrial machinery industry, for example, is related to the emergence of firms producing semiconductor manufacturing equipment, a key input into electronic components. There is, in addition, a basis for forward linkages from electronic components into the electronics-intensive communications equipment, computer, and medical instruments and supplier industries. The significant 50 percent increase from 1988–1994 in the number of high-tech manufacturing establishments provides more circumstantial support for increasing integration.

These structural data offer less support for strong backward linkages to suppliers of more conventional materials and manufactured inputs. Not surprisingly, firms with fewer than 100 employees relied much more on the local market, with a small majority reporting that more than half of their sales were to other companies in the region. However, a strong local supply base does not seem to be a significant factor in the operations of larger high-tech firms.

Local linkages and interfirm networks did seem to offer firms regional competitive advantages in three important areas. First, firms producing microprocessors and other electronic devices reported close relationships with local producers or representatives of small and large process equipment makers. Three of the largest semiconductor equipment makers, Applied Materials, Lam Research, and Tokyo Electron, have major operations in the area, with Austin being the major manufacturing center of Applied Materials. Small and large equipment producers and the original equipment makers (OEMs) each stated that local relationships were both important and intensive. Anecdotal interview information suggested that firms only commit significant resources to networking in transactions involving technology-intensive, highly customized goods or services that have a potentially significant impact on product development or business operations.

The second important local linkage was between companies and local research and development institutions. Strong science and engineering departments at the University of Texas at Austin (UT) and major successes in recruiting public and private R&D institutions in the 1980s created a rich regional research base. MCC, Sematech, and the UT-based Microelectronics Research Center (MRC) are all engaged in applied research on semiconductor materials, design, or process technology, and UT's J.J. Pickle Research Campus lists 20 research units active in engineering, basic sciences, and the social sciences. Thirteen of the 24 firms had formal relationships with one of these research facilities, ten large or medium-sized firms had relationships with more than one of these centers, and several other firms reported more informal or intermittent relationships.

The third important anchor to Austin-based high-tech firms is the broader services and indirect benefits of the University of Texas. Firms reported that UT,

Austin's High Technology Industry Structure

SIC* Industry	Employ-ment 1988	Employ-ment 1994	Location quotient 1988	Location quotient 1994	# of establish-ments 1988	# of establish-ments 1994
High-tech manufacturing	**21,975**	**34,292**			**100**	**149**
355-Special industry machinery	202	938	0.33	1.38	3	7
357-Computer/office equipment	3,565	3,018	3.07	3.23	28	27
366-Communications equipment	1,080	1,340	1.21	1.46	9	14
367-Electronic components/accessories	12,926	25,861	6.75	11.86	26	51
372-Aircraft/parts	1,772	147	0.84	0.08	1	2
382-Measuring/ controlling devices	1,717	1,422	1.66	1.36	24	32
384-Medical instruments/supplies	713	1,566	0.96	1.38	9	16
High-tech services	**12,634**	**19,215**			**838**	**1,401**
737-Computer/data processing services	2,938	5,981	1.26	1.46	204	492
7389-Business services (nec)	1,192	3,457	0.8	1.43	169	258
871-Engineering/ architectural services	6,386	7,065	2.37	2.02	372	521
873-Research/testing services	2,118	2,712	1.72	1.46	93	130
Supplier industries	**2,228**	**3,888**			**75**	**108**
281-Industrial inorganic chemicals	2	70	0.01	0.19	1	4
308-Miscellaneous plastics products (nec)	668	1,116	0.31	0.38	27	37
335-Nonferrous rolling/drawing	135	502	0.24	0.82	2	3
344-Fabricated structural metal products	690	805	0.49	0.49	28	46
349-Miscellaneous fabricated metal products	349	639	0.37	0.57	9	10
362-Electrical industrial apparatus	384	756	0.65	1.15	8	8

* Standard Industrial Classification.

Source: Based upon County Business Patterns data as compiled and estimated by Andrew Isserman, Regional Research Institute, University of West Virginia.

with a large faculty and more than 100 research centers, is a rich source of technical information, consulting, employee training, and highly skilled workers. All the firms interviewed reported that the university is an important site for hiring, but the large and medium-sized firms indicated that the majority of their highly skilled technical and professional workers are hired from outside the region.

Taken as a whole, this evidence suggests that Austin's major high-tech facilities are important centers of research and product development and are, in key ways, embedded in the region's supplier and research base. The university also provides many direct and indirect benefits absent in areas not hosting a major research university.

Evidence of Increasing Local Innovation

Secondary information and the survey suggest that Austin may be evolving into a major center of new product innovation. The amount of important collaboration among firms and local research facilities is increasing. For example, two generations of the Power PC microprocessor originated at Somerset, a local microelectronics consortia that includes IBM, Motorola, and Apple, based on new RISC architecture. IBM research labs have also pioneered new software products, most notably OS2. Indeed, the region's complex has developed an edge as the key design and production center of Intel alternatives, with the Power PC, AMD's K-5 and K-6 chips, and OS2 and Unix software competing on different terms for product applications currently dominated by the Intel-Microsoft combine.

Austin has also become a major center for personal computer production based on the revolutionary organizational innovations of homegrown Dell, which provides the latest generation platforms at competitive prices by avoiding retail overheads and adopting an extreme low inventory, just-in-time production system. This particular organizational system benefits from spatial proximity of marketing, customer support, and production: Dell's operations are much more concentrated in the region than those of rivals pursuing a different strategy.

Evidence suggests that Austin's major high-tech facilities are important centers of research and product development and are, in certain key ways, embedded in the region's supplier and research base.

The remarkable increase in patents registered in the Austin MSA underscores the growing fertility of the region's public and company research base. A little more than 200 patents were registered in 1988, but by 1996, the number had increased to nearly 900, almost double the registrations of Raleigh-Durham and Boston (some Route 128 companies are not included). Austin's large companies remained the primary source of patent registrations with Dell, AMD, IBM, and Motorola accounting for 61 percent of the regional total.

The expansion of local venture capital financing is a final indicator of innovativeness and local high-tech company growth. Until the late 1980s virtually no local venture capital base existed in the region. Small high-tech companies began to lure small venture investments in the early 1990s. Total venture investment in Austin grew to $40 million by 1995, increasing by 65 percent to $66 million by 1996. By 1997 Austin claimed eleven venture capital firms. The rapid growth of venture investment is a strong indirect indicator of vibrant small company formation, again suggesting that the growth process is becoming more endogenously driven. It must be noted, however, that Austin's venture investments remain minuscule compared to the $2.29 billion invested in 552 Silicon Valley companies in 1996.

The Growth of Spin-off and Start-up Companies

One-fourth of the companies surveyed were spin-offs of larger corporations, while 57 percent reported that firms had been founded by ex-employees. A number of spin-off firms trace their roots to the region's major research establishments. MCC spin-offs include Evolutionary Technologies, a software development company with 130 employees. Larger research-oriented manufacturing firms have also generated spin-offs, including PST Technologies, a $10 million company founded by a former AMD employee, and Radian and SPEC, two in a long line of Tracor spin-offs.

Extremely high growth in the number of relatively small establishments suggests considerable momentum in the software

and data processing sector. In addition to Unix and OS2 specialists, a number of smaller companies are competing in rapidly growing segments such as network server software, Internet applications, and multimedia. The most successful homegrown software company, Tivoli Systems, a 330-person firm, was started by former IBM employees. In turn, expatriots from Tivoli founded Dazel, another software firm, in a process typifying a regionally based genesis of new related technology companies.

Conclusion

The construction of Sematech and a decade of uneven but strong growth elevated Austin into the ranks of significant second-tier high-tech cities by the late 1980s. With an attractive blend of classic locational advantages and a unique R&D base, the region has continued to attract major high-tech manufacturing and service firms over the last decade. But a number of indicators presented here suggest this latest growth stage is qualitatively different, and the Austin complex has become much more than an advanced manufacturing or technical branch plant nexus.

Mapping specific companies and their functional specializations to the region's high-tech industries shows that the majority of large Austin firms are engaged in high-end research and product development activities. While still nowhere near the scale of a Silicon Valley, evidence suggests that the Austin high-tech complex has gained innovative momentum in microelectronics, computers, and software and offers specific economies of agglomeration that anchor large firms to the region.

Notes

1. The Austin-San Marcos MSA (Bastrop, Caldwell, Hays, Travis, and Williamson counties) is the main regional designation referred to in this article. It is a reasonably good approximation of an "economic" region defined by commutable distances to workplaces and density patterns.

2. The study was conducted within the Community and Regional Planning Program at the University of Texas at Austin. I would like to thank the members of this research seminar including Matthew Cunningham, Joelle Labrosse, Michael Leach, Maureen Meridith, Dana Merkin, Chris Moore, and Bergan Norris for their primary research on local linkages and the embeddedness of large high-tech establishments, which forms a main part of this article.◆

The Austin complex has become much more than an advanced manufacturing and technical branch plant nexus.

Apace with Progress
Texas Business Review in 1997

December

Why Are Small Technology Firms in Texas Not Competing? Dr. Elsie L. Echeverri-Carroll
Texas in the Information Age, Dr. Sharon Strover and Kyle Nicholas

October

The Internet and Manufacturing, Gary Chapman
Teleworking: Some Texas Initiatives, Dr. Zeny S. Panol

August

Market Opportunities for Recycling in Texas Manufacturing Industries, Dr. Mina M. Dioun
By-Product Synergy: A Strategy for Sustainable Development, Andrew T. Mangan

June

Has Texas Become a Net Importer of Energy Resources? Dr. Jay Zarnikau
Renewable Energy in Texas, John Hoffner

April

Texas Manufacturing Plants that Export, Brent McElreath and Branner Stewart
High-Technology Networks and Exports in Texas, Drs. Elsie L. Echeverri-Carroll, Niles Hanson, and Lynn Hunnicutt

February

Long Term Trends in Manufacturing Employment, Dr. Charles P. Zlatkovich

Texas Business Review is published six times a year (February, April, June, August, October, and December) by the Bureau of Business Research, University of Texas at Austin. Subscriptions are available free upon request. Views expressed in this newsletter are those of the authors and do not necessarily reflect the position of the Bureau of Business Research.

Research and service activities of the Bureau of Business Research focus on the ways Texas industries can become nationally and globally competitive. The Bureau is policy oriented and dedicated to public service. The Bureau is located on the sixth floor of the College of Business Administration building.

Editor: Lois Glenn Shrout
shrout@mail.utexas.edu

Assistant Editor: Sally Furgeson
sallyf@mail.utexas.edu

Sales Office: (512) 471-5179
(512) 471-1063 fax
danhardy@mail.utexas.edu

General: **bbr@uts.cc.utexas.edu**

WWW:
http://www.utexas.edu/depts/bbr/tbr/

BUREAU OF BUSINESS RESEARCH
P.O. Box 7459
Austin, Texas 78713-7459

Change Service Requested

Office of Technology Licensing and Intellectual Property (OTL)

OTL facilitates the transfer of technology developed at the University of Texas at Austin to the private sector for commercialization and public benefit. Currently, more than 70 technologies are available for licensing through OTL, including:

The Foveated Imaging System (FIS) greatly reduces the transmission bandwidth of video or still images. By taking advantage of the space variant resolution of the human eye, it is possible to create an image almost perceptually indistinguishable from a constant resolution image, but requiring substantially less information to code it. FIS differs from typical image compression technology in that there is no perceptual loss at high compression ratios and no loss at and near the point of gaze (wherever a person looks in a given image, no details of that image are lost to the compression method). The resolution reduction scheme and its algorithmic implementation can be readily implemented on personal computers. Applications:

- Telemedicine;
- Virtual reality and other cost-effective simulation, e.g., flight simulators;
- Remote vehicle operation and reconnaissance;
- Video teleconferencing.

$LiFePO_4$ is a new cathode material for secondary (rechargeable) lithium batteries. The insertion and extraction of lithium ions from this material is reversible and the volume change is relatively small. Environmentally benign, the material is much less expensive than $LiCoO_2$ and $LiNiO_2$ and has better electronic conductivity than other iron-based high-voltage cathode material. Applications:

- For rechargeable lithium batteries;
- Under continuing development for low power applications.

Announcement

The **1998 Directory of Texas Manufacturers** will be available in February. Listing more than 16,000 Texas plants, the directory includes product information, sales volume, names of selected officers and, for the first time, Web addresses. Nearly 700 new firms have been added and 65 percent of the 1997 listings updated. The two-volume set is supplemented monthly by reports on new and expanding firms in **Texas Industrial Expansion** (**TIE**). The publications are available as a package for $140 plus tax for Texas residents. **TIE** may be purchased separately for $60 and both publications are available in electronic form. To order, call toll free 1-888-212-4DTM or fax (512) 471-1063. For company information on diskettes or mailing labels, call (512) 471-5180 for details. ◆